Large-scale Submerged Aquatic Vegetation Restoration in the Chesapeake Bay: 2003-2006

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An Agricultural Approach

- Seeds are the most cost effective method for the production of all major domesticated crop plants.

- Seeding offers the most cost effective approach for restoring large, genetically diverse, self-maintaining populations of underwater grasses.

PROBLEMS:

- Information on basic seed physiology lacking
- Protocols for the large-scale collection, storage, and dispersal of SAV seeds were unavailable

Manual SAV Seed Collection

Collect seeds retained in detached stems that accumulate as wrack

Pros: uses seed that would otherwise be unavailable

Cons: seed yields are lower, weather dependent

Collect reproductive shoots directly from actively growing beds

Pros: seed yields are higher, minimal impact to non-reproductive plant structures

Cons: removes seeds from reproductive pool

Better Methods for SAV Seed Collection

An Agricultural Approach

Comparison of 2 types of **mechanical equipment** for eelgrass seed harvest

Commercial harvester for nuisance aquatic vegetation

Pros: readily available

Cons: expensive, limited mobility

VIMS portable boat-mounted harvester

Pros: portable, easily attached to a small boat
Cons: not available commercially, specialized design

Seed Dispersal

Seeds can be dispersed immediately

Photo by MDDNR

Photo by VIMS

Seed Buoys ("Pickerell bags") Pickerell et al 2005; 2006)

Pros: Mimics natural dispersal patterns, low cost, low tech, no expensive seed separation and storage required, avoids potential problems with seed mortality in storage, and swell-suited to volunteer labor

Cons: very labor intensive over short duration, transport logistics, permitting for large deployments can be challenging

Seed Processing

The ability to harvest large volumes of plant reproductive material poses new logistical and technical challenges

Seed processing is a method of isolating the mature seeds from the stems and other less developed reproductive structures

Duration of seed release is a function of the stage of development at which seeds were harvested, water temperature, and the amount of material

Seed processing equipment. Left, large-scale outdoor seed processing tanks for *Z. marina* (Photo by VIMS**). Right, wringer washing machine provides agitation to facilitate seed separation** (Photo by S. Ailstock)**.**

Seed Storage

If seeds are not to be dispersed immediately, they must be stored under conditions that maintain viability and prevent premature germination

Eelgrass seed storage facilities at VIMS

Prior to the start of this research, there was little information available on the specific conditions for SAV seed storage

In some cases, high rates of seed mortality occurred during storage, but factors responsible for seed death were not well understood

Determining the optimum conditions required for seed storage has been a critical research component

An Agricultural Approach to SAV Planting

Mechanized equipment for planting terrestrial crops has been available for more than a century

Development of mechanical equipment for planting underwater grasses is still in its infancy

An Agricultural Approach to SAV Planting

Mechanized equipment for planting adult plants and shoots

(Seagrass Recovery, Inc. Ruskin, FL)

JEB Wheel planter

Pros: can plant much more rapidly than by hand

Cons: plant survival lower than manual planting, not suitable in some sites (i.e. too shallow, too deep, bottom obstructions)

GIGA Planter

Pros: plants 4 x 5 ft sods with intact root, rhizomes, and sediments, good survival and expansion of sods, best suited for ‘salvage’ where damage to existing resources in unavoidable

Cons: not suitable in some sites (i.e. too shallow, too deep, bottom obstructions), limited by distance between donor site and planting site

An Agricultural Approach to SAV Planting

Seed Broadcasting

Eelgrass seed broadcasting has been shown to be effective because seeds are rapidly incorporated into the sediments and generally do not move far from where they settle (Orth et al. 1994).

Photo by VIMS

Manual Seed Broadcasting

Pros: low tech, low cost

Cons: slow, even seed distribution difficult to achieve

Photo by MDDNR

Mechanized Seed Broadcasting

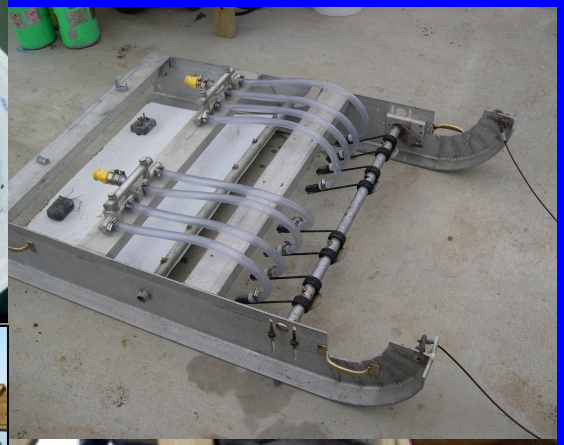
Pros: capable of evenly dispersing seeds at suitable densities (100,000 - 300,000 seeds/acre) at the rate of 10 minutes/acre.

Cons: ??

An Agricultural Approach to SAV Planting

Subsurface Seeding

Concerns with low seed germination rates and possible seed predation effects led to investigation of various means to distribute seeds just below the sediment surface



Photos by VIMS

A mechanical planter capable of injecting seeds suspended in a gel matrix 1-2 cm below the sediment surface was designed and constructed by scientists at the University of Rhode Island (URI, Traber et al. 2003)

An alternative design that does not require a gel matrix for seed delivery was also designed and tested by VIMS